Reina Maruyama develops technologies and carries out experiments to probe the underlying physics of fundamental symmetries, origins of the universe, and nature of neutrinos and dark matter. The Maruyama group uses techniques being developed in the fields of quantum sensor development, atomic, astrophysics, particle, and nuclear physics to solve some of the greatest mysteries of the evolution of the Universe.

Maruyama is an APS Fellow and has been awarded the Sloan Research Fellowship, NSF CAREER Award, Yale Public Voices Fellowship, and CSWP Woman Physicist of the Month. She was chosen by Ingenium to be featured for their Women in STEM initiative and she is the co-leader of Yale’s Asian Americans in STEM initiative.

The Maruyama group is using three different experiments (ALPHA, HAYSTAC, RAY), all located at Wright Lab, to search for dark matter in the form of axions, which are very low mass particles that are a theorized candidate for dark matter.

**Haloscope At Yale Sensitive To Axion CDM (HAYSTAC)**

HAYSTAC (co-led with Steve Lamoreaux) is a tunable radiofrequency cavity resonator, which serves to build up the axion signal. HAYSTAC uses photon sensors often used for quantum computing. It also uses an innovative quantum noise squeezing technique to speed up the data taking of the experiment. HAYSTAC is located at Wright Lab, and the Yale team is responsible for systems engineering, cryogenics, and magnetics.

**Axion Longitudinal Plasma HALoscope (ALPHA)**

ALPHA will build on HAYSTAC’s success and search for higher mass axions by employing a novel axion detector called a plasma haloscope. ALPHA will comprehensively investigate how new experimental ideas using plasmas can be used to detect the axion.

**Rydberg Atom at Yale (RAY)**

To extend the mass range accessible by axion dark matter search experiments, the RAY group is developing a single-photon detector for haloscope experiments, such as HAYSTAC and ALPHA, based on microwave transitions between highly excited Rydberg states in potassium atoms.

**COSINE-100**

COSINE-100 is a direct-detection dark matter experiment at the Yangyang Underground Laboratory in South Korea designed to test the DAMA/LIBRA Collaboration’s claim that they have made a direct detection of dark matter, based on an annual modulation they observed in their data. COSINE aims to understand the origin of DAMA’s signal and search for their reported annual modulation signature by using the same target and detector material. Maruyama is the Principal Investigator of COSINE-100 and the scientific co-spokesperson of the experiment.

**CUORE/CUPID**

CUORE, and its successor CUPID, located in Italy, are searching for a previously undetected process called neutrinoless double beta decay. If such a process is observed, it would mean that neutrinos are their own antiparticles, and may hold the clue to why we live in a Universe of matter, and not antimatter.

Maruyama and Karsten Heeger are co-Principal Investigators of CUORE. The Wright Lab team has been responsible for the design, construction, and commissioning of the CUORE Detector Calibration System; analysis and simulation of data; and R&D.

[maruyama-lab.yale.edu](http://maruyama-lab.yale.edu)